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INVESTIGATION OF NEAR SURFACE AEROSOL PROPERTIES IN ARID REGION--ETC(U)
AUG 78 J M ROSEN, D J HOFMANN DAAG29-78-G-0048
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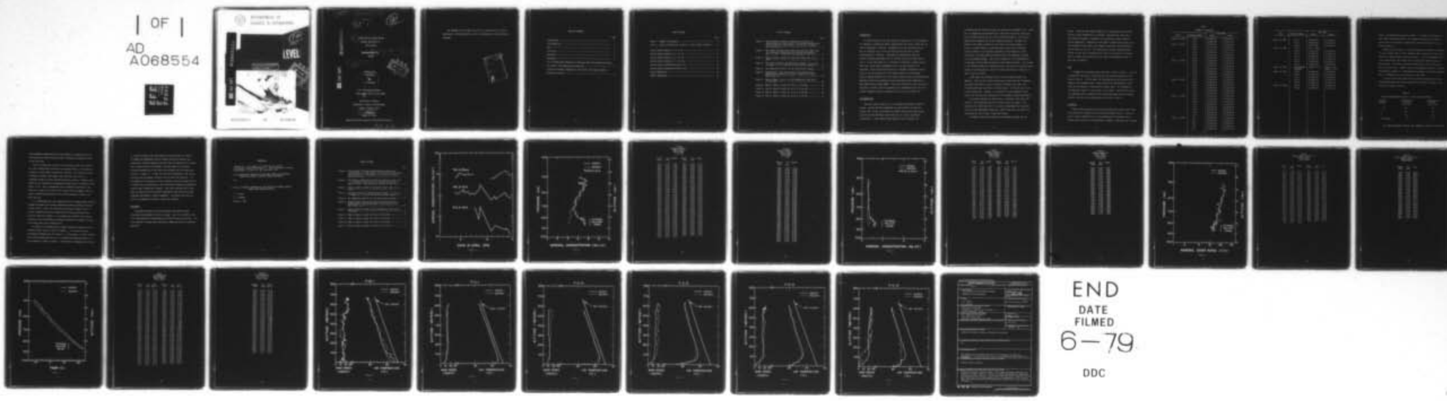

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6 INVESTIGATION OF NEAR SURFACE
AEROSOL PROPERTIES IN
ARID REGIONS .

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REPORT

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

In recent years more and more effort has been given to the development of atmospheric transmission models representative of various conditions and types of geographic locations. Throughout the lower altitudes aerosols play an important role in the extinction process and hence a model describing them is required. Unfortunately comprehensive data sets needed to develop such models are for the most part non-existent and in fact it is not even known if it is possible to construct a useful aerosol model for a given type of geographic site. The work reported here represents a first step by the University of Wyoming, atmospheric physics group to try and characterize near surface aerosols in arid regions. Using a tethered balloon and a free balloon system aerosol and meteorological parameter profiles were measured during windy spring time conditions at White Sands Missile Range (WSMR). The initial objective of this work was to determine if surface aerosol measurements are representative of the first several kilometers above the sampling site (in this case ARKY site).

INSTRUMENTATION

The basic aerosol detector is a two channel photoelectric particle counter. During the field experiment the concentration of particles greater than .30 and .50 micrometers diameter were measured and on some occasions the discriminator levels were set at .5 and 3 micrometers respectively. A more complete description of the instrument, the calibration and the overall accuracy has been given by Hofmann *et al.*, (1975). The air temperature was measured with a small bead thermistor (about 2mm dia.) shielded from the sun in a force ventilated housing. The relative humidity was determined by the wet temperature method. Although this method is not highly reliable for low values of relative humidity, it served a valuable purpose in providing upper limits which eliminated relative humidity as an important parameter in explaining the aerosol variations. The wind speed was measured with a cup anemometer fastened to the instrument package. Small errors develop in this measurement due to swinging of the package and motion of the tethered balloon. The altitude of the tethered balloon was determined from a very sensitive pressure sensor capable of resolving about 1 meter of altitude and having a stability of about 1 meter or better.

A 2500 cubic foot tethered balloon, with an expansion panel was employed. The tail fins of this balloon are in part made out of aluminum tubing and after about a week of continual flexing in the wind, they developed weak spots and broke in several places. We believe this to be a basic design flaw. However, it was possible to make temporary field repairs and continue the soundings but with somewhat degraded performance.

The tethered balloon was controlled by a hydraulic winch that could produce a very respectable torque at either high or low speed. Past experience has shown that this is a necessary requirement for successful control of the measurement conditions. Most of the data was taken at an ascent/descent rate of about 1 meter per second.

A telemetry link was used between the instrument package and the ground. There was some limited capability of displaying real time data but most of the information was recorded. Experience has shown that a real time data display is necessary to successfully conduct tethered balloon operations. Originally we had hoped to produce high quality real time displays of data with a mini computer system but time and funding did not allow us to do so. In evaluating the overall tethered balloon system, we feel that it performed quite well in the field but at present there is really no satisfactory way to reduce the tremendous volume of data that it produces.

DATA

A summary of the sounding dates and times is given in Table 1. It will be noted that the details concerning the free balloon sounding are also given in Table 1. In this report the sounding results are given in both graphical and tabulated form. Ascent profiles are represented by solid lines and the descent is represented by dashed lines. For reference in the temperature profile a dry adiabat is also shown. The data and time of the soundings shown in graphical form can be determined from the sounding number at the top of the graph along with the use of Table 1.

DISCUSSION

Almost without exception the aerosol concentration profiles were found to be essentially constant with altitude above about 4 meters. This fact allows a great simplification in the presentation of the aerosol data because only one value of concentration is needed to represent each sounding.

TABLE I

SUMMARY OF SOUNDINGS

Date	Sounding Number	Time (MST) Ascent	Descent
April 3, 1978	3-D-1	22:38/22:57	22:57/23:03
	3-D-2	23:09/23:30	23:35/23:53
April 4, 1978	4-B-1	11:30/11:41	11:42/11:52
	4-B-2	11:53/12:03	12:03/12:12
	4-B-3	12:14/12:19	12:21/12:30
	4-C-1	16:33/16:46	17:01/17:17
	4-C-2	17:22/17:32	17:33/17:42
	4-C-3	17:43/17:49	17:53/18:00
April 5, 1978	5-B-1	11:36/11:48	11:52/12:04
	5-C-1	17:08/17:27	17:29/17:42
	5-C-2	17:47/17:57	17:57/18:08
	5-C-3	18:13/18:23	18:23/18:33
	5-C-4	19:03/19:14	19:14/19:25
	5-C-5	19:25/19:34	19:34/19:42
	5-C-6	19:43/19:56	19:56/20:04
April 6, 1978	6-B-1	11:46/11:55	11:56/12:05
	6-B-2	12:06/12:14	12:15/12:23
	6-B-3	12:26/12:27	12:27/12:29
	6-C-1	16:08/16:22	16:23/16:30
	6-C-2	16:33/16:40	16:43/16:48
	6-C-3	16:56/17:05	17:07/17:20
April 7, 1978	7-B-1	11:36/11:44	11:44/11:53
	7-B-2	11:55/12:02	12:03/12:12
	7-B-3	12:13/12:20	12:21/12:32
	7-C-1	18:09/18:17	18:18/18:26
	7-C-2	18:27/18:34	18:35/18:43
	7-C-3	20:02/20:11	20:11/20:20
	7-C-4	20:22/20:31	20:32/20:50
	7-C-5	20:55/21:15	21:16/21:33
April 8, 1978	8-1	12:53/13:11	13:11/13:19
	8-2	13:21/13:28	13:29/13:37
	8-3	13:53/14:01	14:02/14:12
	8-4	15:27/15:35	15:36/15:52
	8-5	17:09/17:26	17:27/17:43

Date	Sounding Number	Time (MST) Ascent	Descent
April 10, 1978	10-C-1	18:23/18:36	18:37/18:50
	10-C-2	18:56/19:08	19:14/19:26
	10-C-3	19:27/19:48	19:50/20:03
April 11, 1978	11-B-1	11:32 - Abort	
	11-B-2	11:42/11:53	11:55/12:09
	11-B-3	12:15/12:21	12:22/12:28
	11-C-1	16:36/16:53	16:54/17:12
	11-C-2	17:14/17:35	17:36/17:48
	11-C-3	17:53/18:08	18:08/18:21
	11-C-4	18:22/18:34	18:36/18:48
April 12, 1978	Free Balloon Sounding	Launch: 11:41	Burst 12:05; Impact: 12:19
April 13, 1978	13-B-1	11:35/11:48	11:49/12:03
	13-B-2	12:04/12:18	12:18/12:31
	13-C-1	16:10/16:27	16:27/16:40
	13-C-2	16:48/17:02	17:04/17:14
	13-C-3	17:33/17:42	17:42/17:54
April 14, 1978	14-B-1	11:32/11:45	11:45/11:57
	14-B-2	11:59/12:11	12:11/12:26

Figure 1 was generated using this approach. It should be noted that in this figure the concentration of the largest size particles (diameter greater than 3 μm) decreases significantly after the passage of a cold front on April 10.

During the day on April 8, the winds gradually increased in intensity to such an extent that at about 1800 MST a gust in excess of 50 knots was observed at about 30 meters above the ground. It was also apparent from visual observations that blowing dust was much more prominent than on previous days. On several occasions during the day, dust devils passed near or over the site. Figure 1 shows a corresponding increase in aerosol concentration on April 8. Unfortunately the channel for particles greater than .3 μm diameter was not operational at this time.

In spite of the windy conditions the aerosol concentration did not change appreciably with altitude except for the lowest few meters. This variation is shown in Table II.

TABLE II

Aerosol Concentration on April 8, 1978 at about 1800 MST

Altitude (meters)	Concentration No./cm^3 Dia $\geq$ .5 μm	Concentration No./cm^3 Dia $\geq$ 3 μm
.15	55	8.1
2	50	5.2
3	12.5	1.2
5 and above	2.9	.27

The highest readings represent mass loadings in excess of 500 $\mu gm/m^3$.

These anamalous concentrations near the ground are probably due to the wind picking up surface material freshly loosened by personnel activity in the local area.

Since no significant structure in the aerosol profile was observed over the altitude range covered by the tethered balloon, a free balloon sounding to a much higher altitude was conducted. The results are shown in Figures 2 through 5 and suggest that even here there is not a tremendous change in aerosol concentration with altitude. However, there appears to be a significant disagreement between ascent and descent in the lowest 1.5 km. This is undoubtedly due to different conditions at the impact site (about 10 km south of the launch site) and suggests that the aerosol concentrations observed at the surface prevails to about 1 km above the site.

It is unfortunate that the sounding did not go slightly higher and pass through the primary fair weather temperature inversion normally observed at about 500 mb. Above this temperature inversion a dramatic drop in aerosol concentration would be expected and the entire boundary layer would have been well defined. It was hoped that additional free balloon soundings could be performed but scheduling problems and sporatic closings of the Range made this an impossibility.

An example of the meteorological support parameters measured with the tethered balloon system is shown in Figures 6 - 11 in which the time development throughout the day on April 7 is illustrated. At about 1200 MST when surface heating from the sun is a maximum the temperature profile is very irregular as shown in Figure 6. We believe the irregularities are due to rising air parcels that were heated at the relatively hot surface. At sundown the temperature profile becomes noticiably smoother and a temperature inversion develops within the first few meters of the surface due to rapid cooling of the ground. The wind speed at the surface decreases probably due to the stability associated with the temperature inversion. Figures 9 - 11 show the continued development of the surface inversion and the gradual cooling of the air above the inversion. The development of the inversion is also reflected in the wind speed profiles. It should also be noticed that a short time after sundown the temperature profiles again became more irregular. This seems contradictory to what might be expected since the surface temperature inversion would inhibit turbulence and promote a stable atmosphere. At present there does not seem to be enough data on hand to settle this question.

CONCLUSION

The primary results of this work indicate the surface aerosol concentration measurements in the size range .3 μm to 3 μm diameter seem to be representative of approximately the first km above the surface. This result applies to spring time conditions at WSMR and may not be generally applicable.

REFERENCES

Hofmann, D.J., J.M. Rosen, T.J. Pepin and R.G. Pinnick
Stratospheric Aerosol Measurements I: Time Variations at Northern Midlatitudes, J. Atmos. Sci. 32, 1446-1456, 1975.

LIST OF MANUSCRIPTS SUBMITTED OR PUBLISHED UNDER ARO SPONSORSHIP DURING THIS PERIOD, INCLUDING JOURNAL REFERENCES

None

SCIENTIFIC PERSONNEL SUPPORTED BY THIS PROJECT AND DEGREES AWARDED DURING THIS REPORTING PERIOD

J. M. Rosen

D. J. Hofmann

Degrees - None

FIGURE CAPTIONS

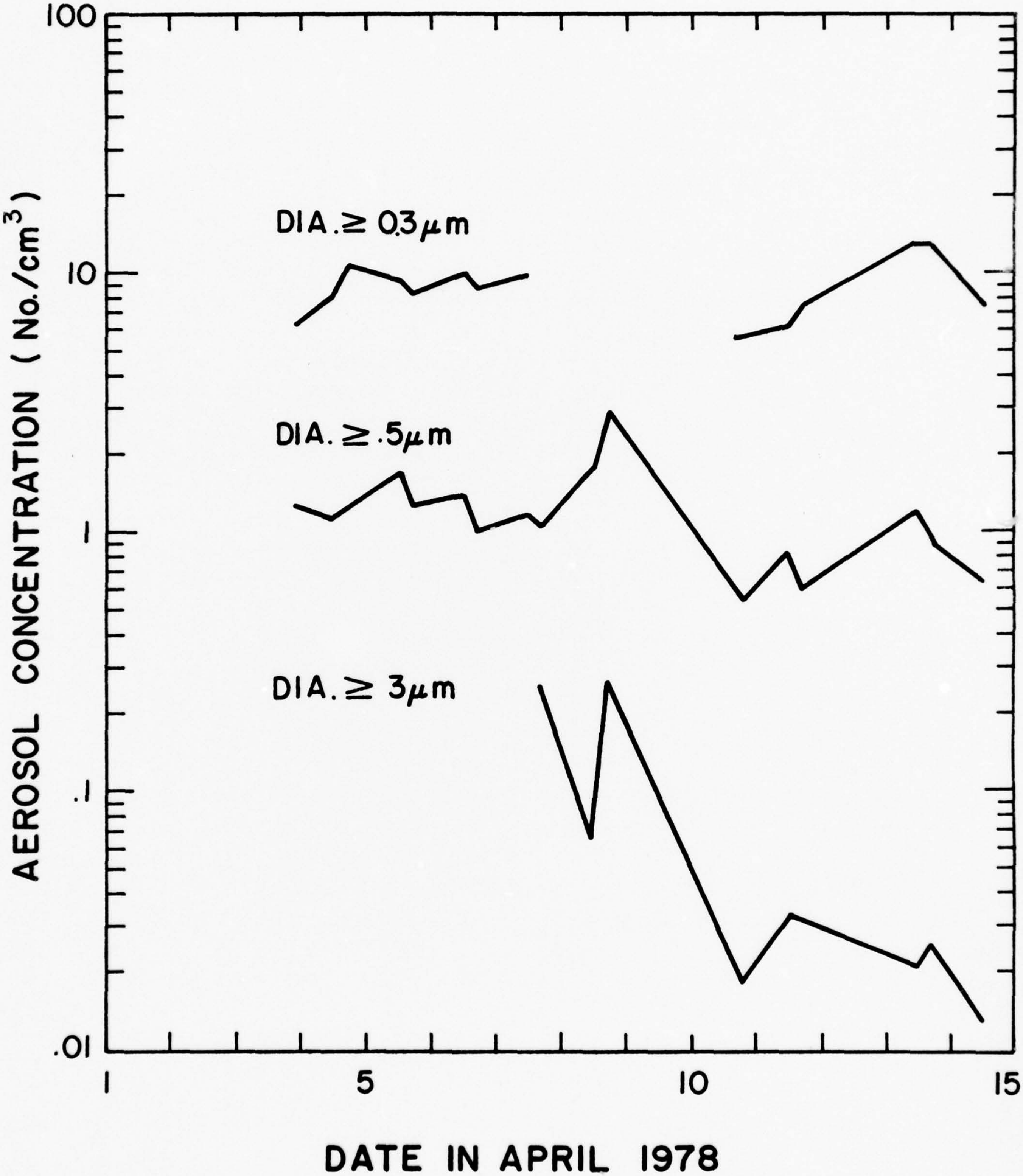
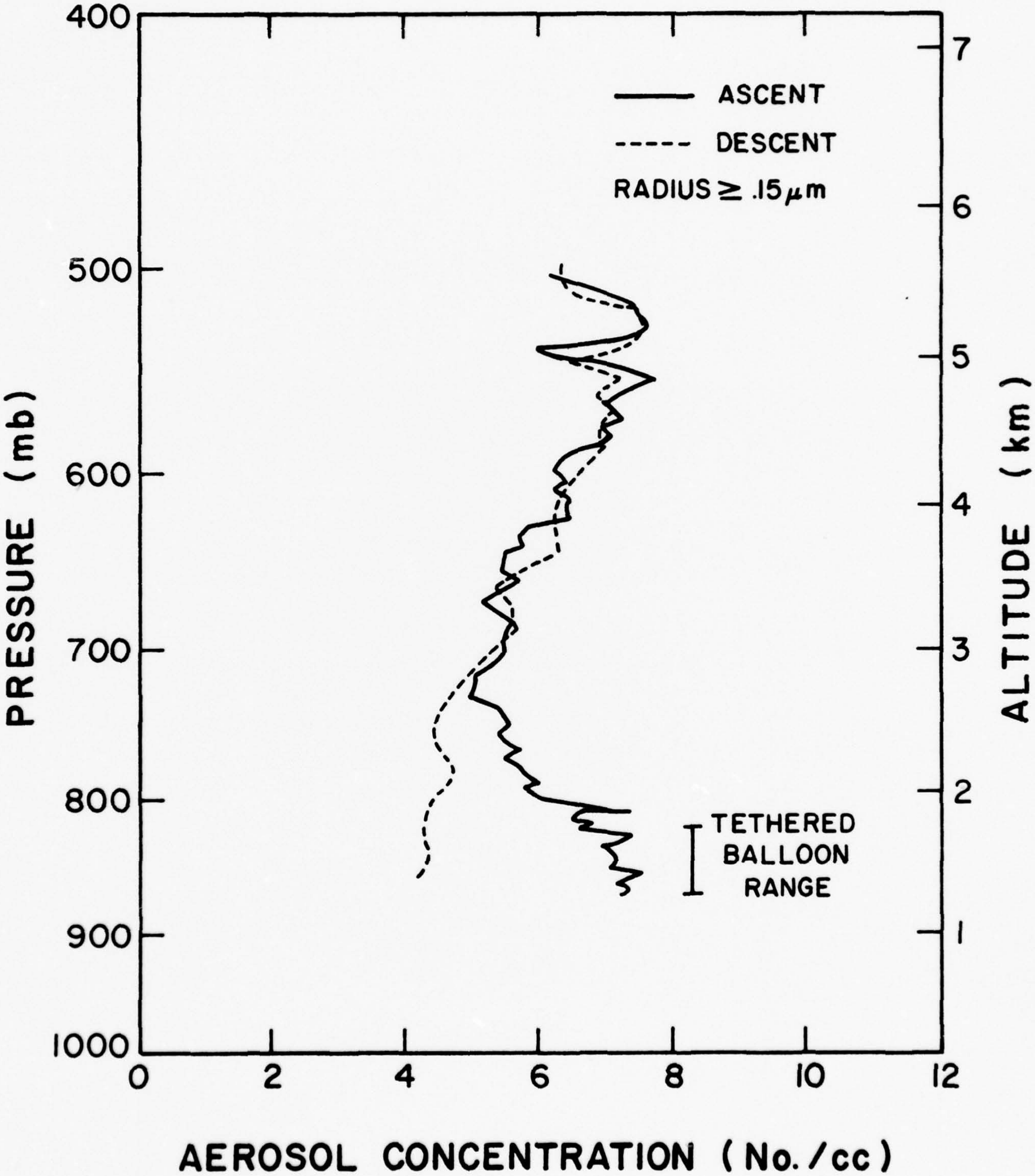

100
10
1
.1
.01
AEROSOL CONCENTRATION (No./cm³)
DIA. ≥ 0.3μm
DIA. ≥ .5μm
DIA. ≥ 3μm
1
5
10
15
DATE IN APRIL 1978

Figure 1.



ASCENT
DESCENT
RADIUS ≥ .15 μm
TETHERED BALLOON RANGE
PRESSURE (mb)
ALTITUDE (km)
400
500
600
700
800
900
1000
0
2
4
6
8
10
12
1
2
3
4
5
6
7
AEROSOL CONCENTRATION (No./cc)

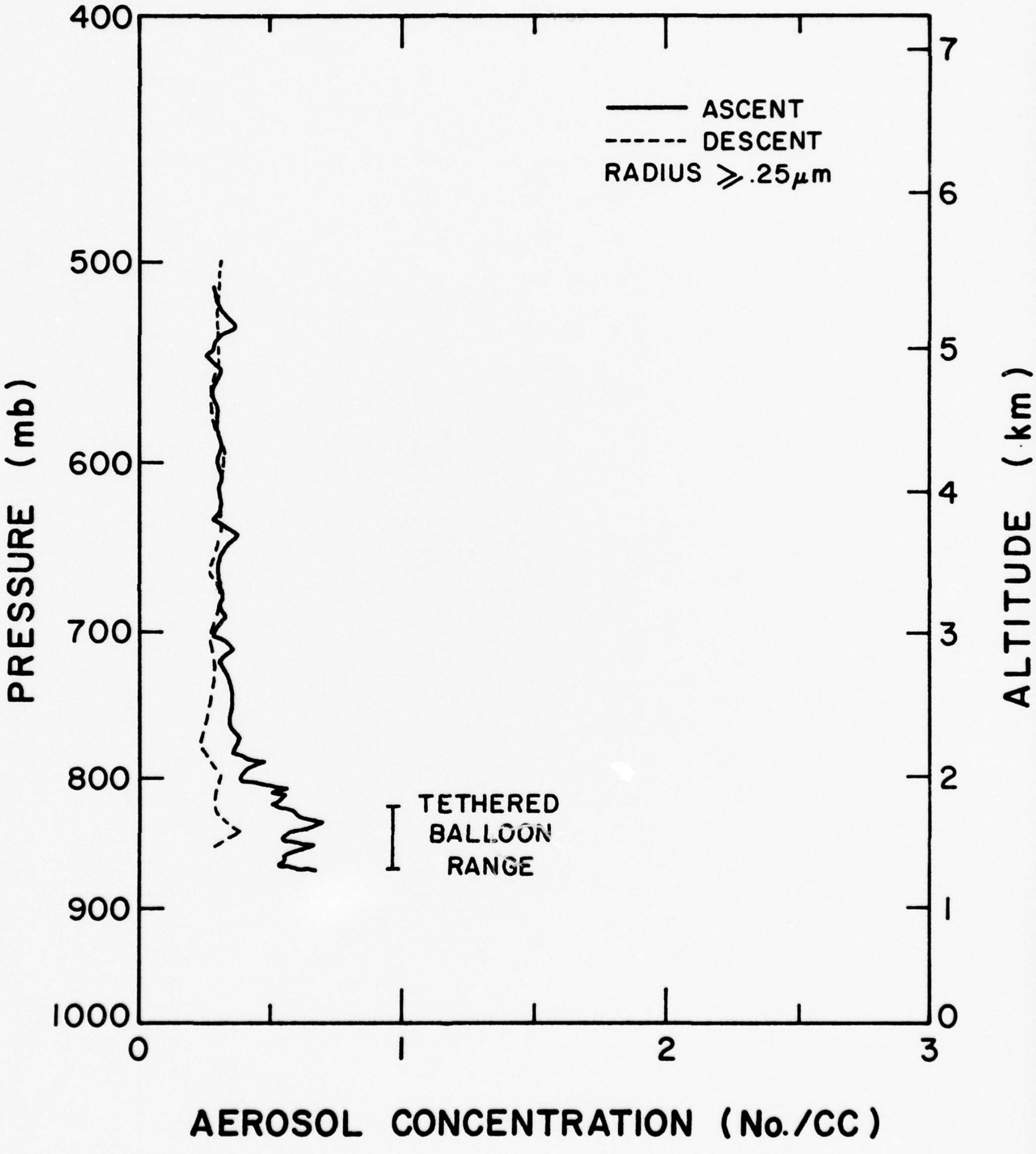
Figure 2.

ASCENT
AEROSOL CHANNEL I
WHITE SANDS-1
WHITE SANDS
r $\geq$.15 μm

PRESS (MB)	ALT (KM)	NO/CC	PRESS (MB)	ALT (KM)	NO/CC
871.	1.22	7.23	671.	3.41	5.17
867.	1.26	7.35	664.	3.49	5.49
864.	1.29	7.34	659.	3.56	5.74
859.	1.34	7.14	653.	3.63	5.46
853.	1.40	7.57	648.	3.70	5.50
849.	1.44	7.09	642.	3.77	5.54
845.	1.48	7.16	639.	3.81	5.78
839.	1.54	7.19	633.	3.88	5.73
834.	1.59	6.93	628.	3.94	5.87
830.	1.63	7.29	623.	4.01	6.50
825.	1.69	7.40	618.	4.08	6.40
821.	1.73	6.61	614.	4.13	6.49
818.	1.76	6.83	609.	4.19	6.24
814.	1.80	6.50	604.	4.26	6.44
810.	1.84	6.51	598.	4.34	6.27
808.	1.87	6.69	593.	4.40	6.39
807.	1.88	7.40	589.	4.47	6.59
806.	1.88	6.68	585.	4.52	6.97
802.	1.93	6.48	580.	4.58	7.12
799.	1.96	6.00	576.	4.64	6.95
796.	1.99	5.90	572.	4.70	7.28
791.	2.04	5.78	569.	4.74	7.19
787.	2.09	6.02	564.	4.80	7.03
782.	2.14	5.80	560.	4.86	7.22
777.	2.19	5.75	556.	4.92	7.42
772.	2.25	5.52	552.	4.97	7.77
766.	2.31	5.74	548.	5.03	7.44
761.	2.36	5.53	544.	5.08	7.17
755.	2.44	5.40	541.	5.13	6.28
749.	2.50	5.59	536.	5.20	5.99
744.	2.56	5.48	532.	5.26	7.35
738.	2.63	5.44	528.	5.32	7.65
730.	2.72	5.01	525.	5.36	7.66
724.	2.79	5.10	521.	5.43	7.53
716.	2.88	5.06	518.	5.47	7.49
710.	2.95	5.35	515.	5.52	7.30
702.	3.04	5.53	510.	5.59	6.89
697.	3.10	5.49	507.	5.64	6.51
690.	3.19	5.53	503.	5.69	6.24
684.	3.26	5.63	499.	5.76	6.53
678.	3.33	5.41			

DESCENT
AEROSOL CHANNEL I
WHITE SANDS-1
WHITE SANDS
r $\geq$.15μm

PRESS (MB)	ALT (KM)	NO/CC
499.	5.78	6.38
507.	5.66	6.33
514.	5.56	6.53
521.	5.45	7.58
529.	5.33	7.56
538.	5.19	7.34
545.	5.10	6.47
553.	4.98	7.31
561.	4.87	6.83
569.	4.77	7.13
578.	4.64	6.90
587.	4.51	7.05
595.	4.41	6.76
602.	4.32	6.62
609.	4.23	6.41
615.	4.14	6.36
623.	4.05	6.23
630.	3.95	6.29
638.	3.86	6.27
645.	3.77	6.33
653.	3.66	5.83
663.	3.55	5.32
672.	3.44	5.58
681.	3.34	5.54
689.	3.23	5.67
698.	3.13	5.31
709.	3.01	5.17
720.	2.88	4.88
731.	2.76	4.68
742.	2.63	4.54
752.	2.51	4.44
764.	2.39	4.42
775.	2.26	4.74
786.	2.15	4.68
797.	2.03	4.44
810.	1.90	4.34
823.	1.76	4.25
834.	1.65	4.39
844.	1.54	4.34
854.	1.44	4.24
863.	1.36	4.38



400
500
600
700
800
900
1000
PRESSURE (mb)
0
1
2
3
AEROSOL CONCENTRATION (No./CC)
7
6
5
4
3
2
1
0
ALTITUDE (km)
ASCENT
DESCENT
RADIUS ≥ .25 μm
TETHERED
BALLOON
RANGE

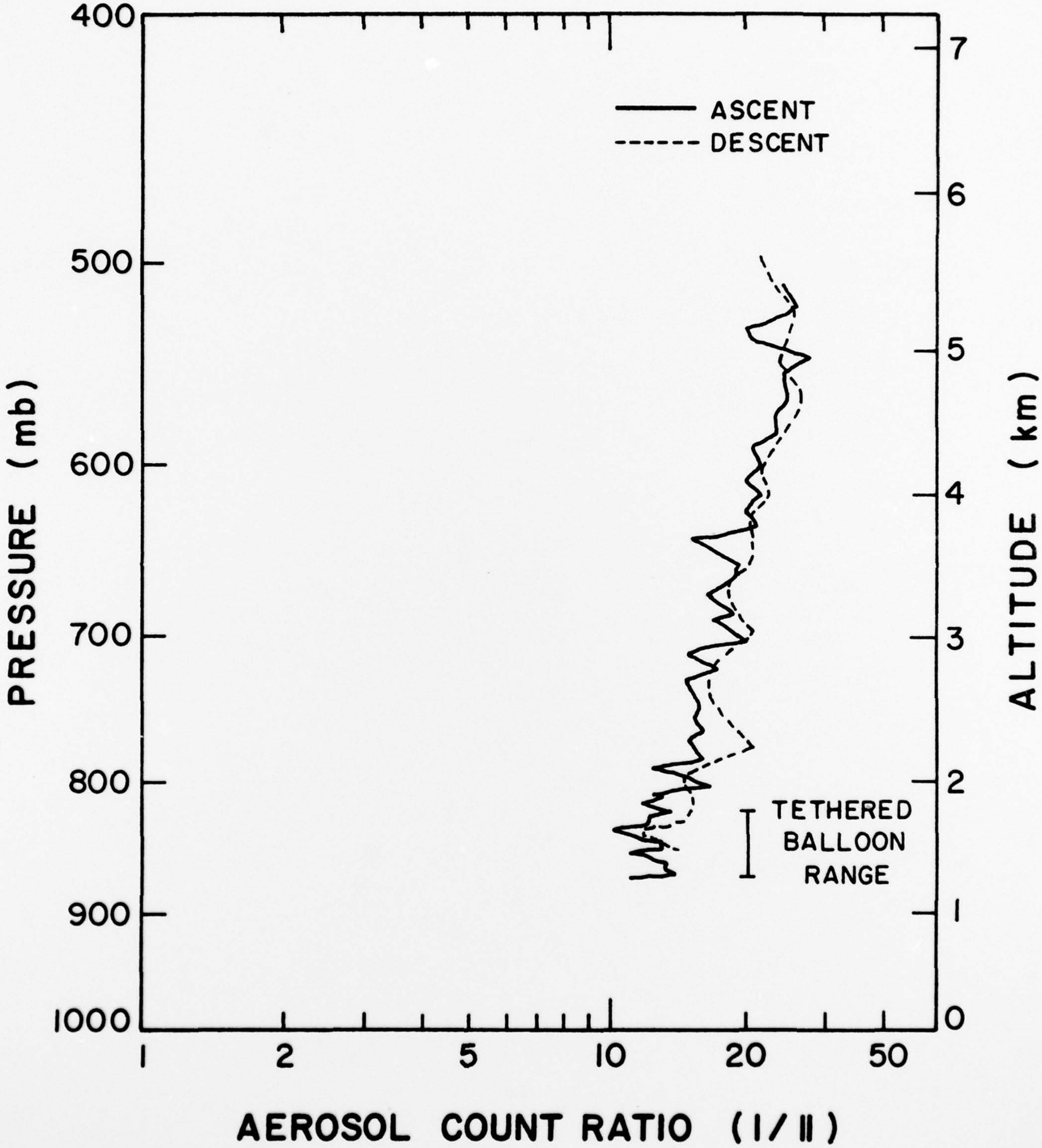
Figure 3.

ASCENT
AEROSOL CHANNEL II
WHITE SANDS-1
WHITE SANDS
r ≥.25 μm

PRESS (MB)	ALT (KM)	NO/CC	PRESS (MB)	ALT (KM)	NO/CC
870.	1.23	.659	720.	2.83	.296
867.	1.26	.521	711.	2.94	.361
864.	1.29	.553	702.	3.05	.275
857.	1.36	.549	691.	3.17	.330
851.	1.42	.670	683.	3.27	.302
847.	1.46	.543	674.	3.37	.325
842.	1.51	.549	664.	3.49	.297
837.	1.56	.653	656.	3.60	.293
833.	1.61	.701	649.	3.69	.323
828.	1.66	.603	641.	3.78	.378
823.	1.70	.584	633.	3.88	.276
819.	1.75	.497	625.	3.98	.315
813.	1.81	.555	616.	4.11	.298
811.	1.83	.507	609.	4.20	.317
808.	1.86	.507	599.	4.33	.292
807.	1.87	.564	590.	4.44	.320
805.	1.90	.493	583.	4.54	.301
802.	1.93	.382	574.	4.66	.310
798.	1.97	.380	566.	4.77	.284
793.	2.02	.403	558.	4.89	.297
788.	2.07	.482	552.	4.97	.325
782.	2.14	.360	544.	5.08	.258
778.	2.18	.366	536.	5.20	.295
769.	2.28	.380	530.	5.28	.378
762.	2.36	.345	524.	5.37	.339
754.	2.44	.354	517.	5.48	.291
746.	2.53	.352	510.	5.59	.288
738.	2.62	.356	503.	5.69	.282
730.	2.72	.347			

DESCENT
AEROSOL CHANNEL II
WHITE SANDS-1
WHITE SANDS
r $\geq$.25 μm

PRESS (MB)	ALT (KM)	NO/CC
498.	5.80	.307
510.	5.61	.285
523.	5.42	.296
536.	5.22	.306
549.	5.04	.297
563.	4.84	.260
578.	4.65	.281
604.	4.29	.314
616.	4.14	.286
629.	3.97	.313
642.	3.80	.306
656.	3.63	.282
670.	3.46	.305
684.	3.30	.302
699.	3.11	.256
717.	2.91	.289
731.	2.76	.287
746.	2.58	.271
775.	2.26	.228
781.	2.20	.254
796.	2.04	.307
811.	1.88	.283
826.	1.73	.287
839.	1.60	.376
851.	1.48	.286
862.	1.37	.319



PRESSURE (mb)
400
500
600
700
800
900
1000
ALTITUDE (km)
7
6
5
4
3
2
1
0
ASCENT
DESCENT
TETHERED
BALLOON
RANGE
1
2
5
10
20
50
AEROSOL COUNT RATIO (I/II)

Figure 4.

ASCENT
RATIO AEROSOL CHANNEL I/II
WHITE SANDS-1
WHITE SANDS

PRESS (MB)	ALT (KM)	I/II	PRESS (MB)	ALT (KM)	I/II
870.	1.23	11.0	720.	2.83	17.1
867.	1.26	14.1	711.	2.94	14.7
864.	1.29	13.3	702.	3.05	20.1
857.	1.36	13.2	691.	3.17	16.7
851.	1.42	11.0	683.	3.27	18.5
847.	1.46	13.1	674.	3.37	16.3
842.	1.51	13.1	664.	3.49	18.5
837.	1.56	10.8	656.	3.60	19.0
833.	1.61	10.1	649.	3.69	17.0
828.	1.66	12.2	641.	3.78	14.9
823.	1.70	12.2	633.	3.88	20.8
819.	1.75	13.6	625.	3.98	19.8
813.	1.81	11.7	616.	4.11	21.6
811.	1.83	12.8	609.	4.20	19.7
808.	1.86	13.1	599.	4.33	21.5
807.	1.87	12.5	590.	4.44	20.4
805.	1.90	13.4	583.	4.54	23.4
802.	1.93	16.8	574.	4.66	22.9
798.	1.97	15.7	566.	4.77	25.0
793.	2.02	14.5	558.	4.89	24.6
788.	2.07	12.3	552.	4.97	24.0
782.	2.14	16.1	544.	5.08	27.8
778.	2.18	15.7	536.	5.20	20.4
769.	2.28	14.8	530.	5.28	19.8
762.	2.36	16.1	524.	5.37	22.6
754.	2.44	15.3	517.	5.48	25.6
746.	2.53	15.7	510.	5.59	23.9
738.	2.62	15.3	503.	5.69	22.3
730.	2.72	14.4			

DESCENT
RATIO AEROSOL CHANNEL I/II
WHITE SANDS-1
WHITE SANDS

PRESS (MB)	ALT (KM)	I/II
498.	5.80	20.8
510.	5.61	22.5
523.	5.42	25.6
536.	5.22	24.1
549.	5.04	23.3
563.	4.84	26.6
578.	4.65	24.6
604.	4.29	20.8
616.	4.14	22.2
629.	3.97	20.1
642.	3.80	20.6
656.	3.63	20.1
670.	3.46	18.1
684.	3.30	18.5
699.	3.11	20.7
717.	2.91	17.1
731.	2.76	16.3
746.	2.58	16.6
775.	2.26	20.8
781.	2.20	18.5
796.	2.04	14.5
811.	1.88	15.3
826.	1.73	15.0
839.	1.60	11.6
851.	1.48	15.0
862.	1.37	13.7

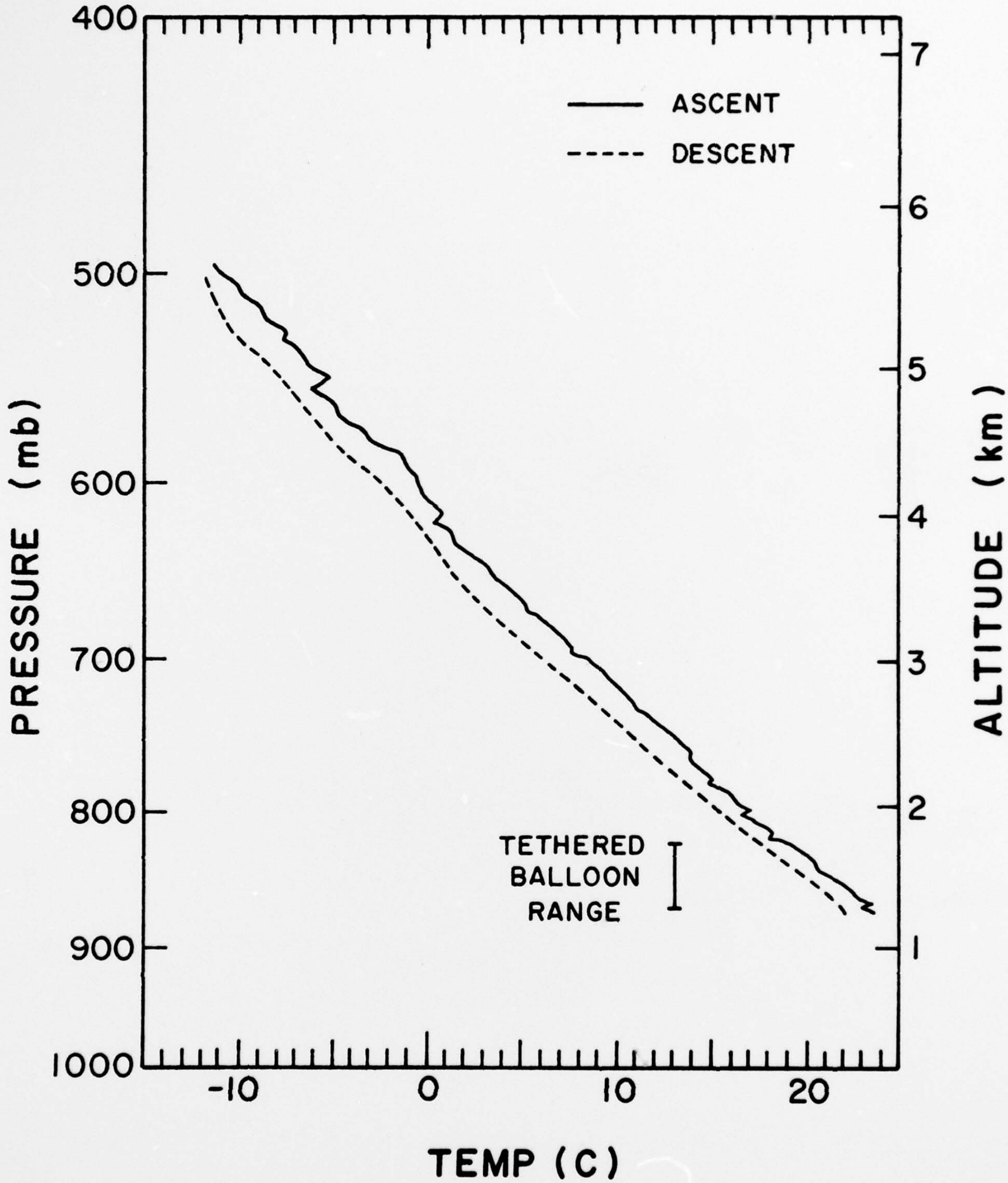

ASCENT
DESCENT
TETHERED
BALLOON
RANGE
PRESSURE (mb)
400
500
600
700
800
900
1000
ALTITUDE (km)
7
6
5
4
3
2
1
-10
0
10
20
TEMP (C)

Figure 5.

ASCENT
AIR TEMPERATURE
WHITE SANDS-1
WHITE SANDS

PRESS (MB)	ALT (KM)	TEMP (DEG C)	PRESS (MB)	ALT (KM)	TEMP (DEG C)
872.	1.21	23.7	713.	2.91	9.80
870.	1.23	23.4	708.	2.97	9.30
868.	1.25	23.0	702.	3.04	8.80
866.	1.27	23.6	697.	3.10	7.80
864.	1.29	22.9	691.	3.17	7.50
864.	1.29	22.9	685.	3.24	7.10
850.	1.43	21.8	680.	3.30	6.50
847.	1.46	21.5	678.	3.33	6.30
844.	1.49	20.9	672.	3.40	5.50
841.	1.52	20.7	667.	3.47	5.15
839.	1.55	20.5	661.	3.53	4.66
836.	1.57	20.5	656.	3.60	4.17
833.	1.60	20.4	650.	3.67	3.50
830.	1.63	19.9	645.	3.74	3.25
825.	1.69	19.2	639.	3.81	2.40
822.	1.72	19.0	634.	3.88	1.52
819.	1.75	18.1	628.	3.94	1.43
816.	1.78	18.3	623.	4.02	.540
813.	1.81	18.1	617.	4.09	.990
811.	1.84	17.9	612.	4.16	.450
808.	1.87	17.3	607.	4.23	-.190
805.	1.90	17.2	601.	4.30	-.380
802.	1.93	16.6	596.	4.37	-.650
799.	1.95	17.1	590.	4.44	-1.12
797.	1.98	16.5	585.	4.52	-1.31
794.	2.01	16.3	579.	4.59	-2.85
791.	2.04	16.3	574.	4.67	-3.17
788.	2.07	16.1	569.	4.74	-4.57
785.	2.10	15.9	560.	4.85	-4.79
783.	2.13	15.3	552.	4.97	-6.15
780.	2.16	15.0	547.	5.04	-5.13
777.	2.19	15.1	542.	5.12	-6.27
769.	2.28	14.1	536.	5.20	-6.50
763.	2.35	13.9	530.	5.29	-7.52
758.	2.41	14.0	525.	5.36	-7.46
752.	2.47	13.3	520.	5.44	-8.56
746.	2.53	12.8	515.	5.52	-8.69
741.	2.59	12.3	509.	5.60	-9.71
735.	2.66	11.8	504.	5.68	-9.91
732.	2.70	11.2	499.	5.76	-11.0
724.	2.78	10.8	496.	5.80	-11.2
719.	2.85	10.2			

DESCENT
AIR TEMPERATURE
WHITE SANDS-1
WHITE SANDS

PRESS (MB)	ALT (KM)	TEMP (DEG C)
496.	5.82	-11.2
501.	5.74	-11.6
507.	5.66	-11.5
515.	5.54	-11.0
523.	5.42	-10.3
531.	5.30	-9.71
536.	5.22	-8.69
542.	5.15	-8.37
550.	5.03	-7.46
558.	4.91	-6.74
563.	4.84	-6.15
569.	4.77	-5.81
585.	4.54	-4.13
591.	4.47	-3.70
596.	4.40	-2.56
610.	4.22	-1.50
623.	4.04	-.380
637.	3.87	.450
651.	3.70	1.43
664.	3.53	2.39
678.	3.36	3.83
692.	3.20	5.23
706.	3.04	6.51
720.	2.88	7.84
733.	2.72	9.36
747.	2.57	10.5
764.	2.38	11.8
775.	2.26	13.1
788.	2.13	14.2
803.	1.97	15.4
817.	1.82	16.8
831.	1.68	18.1
845.	1.53	19.4
859.	1.39	21.1
867.	1.31	21.6

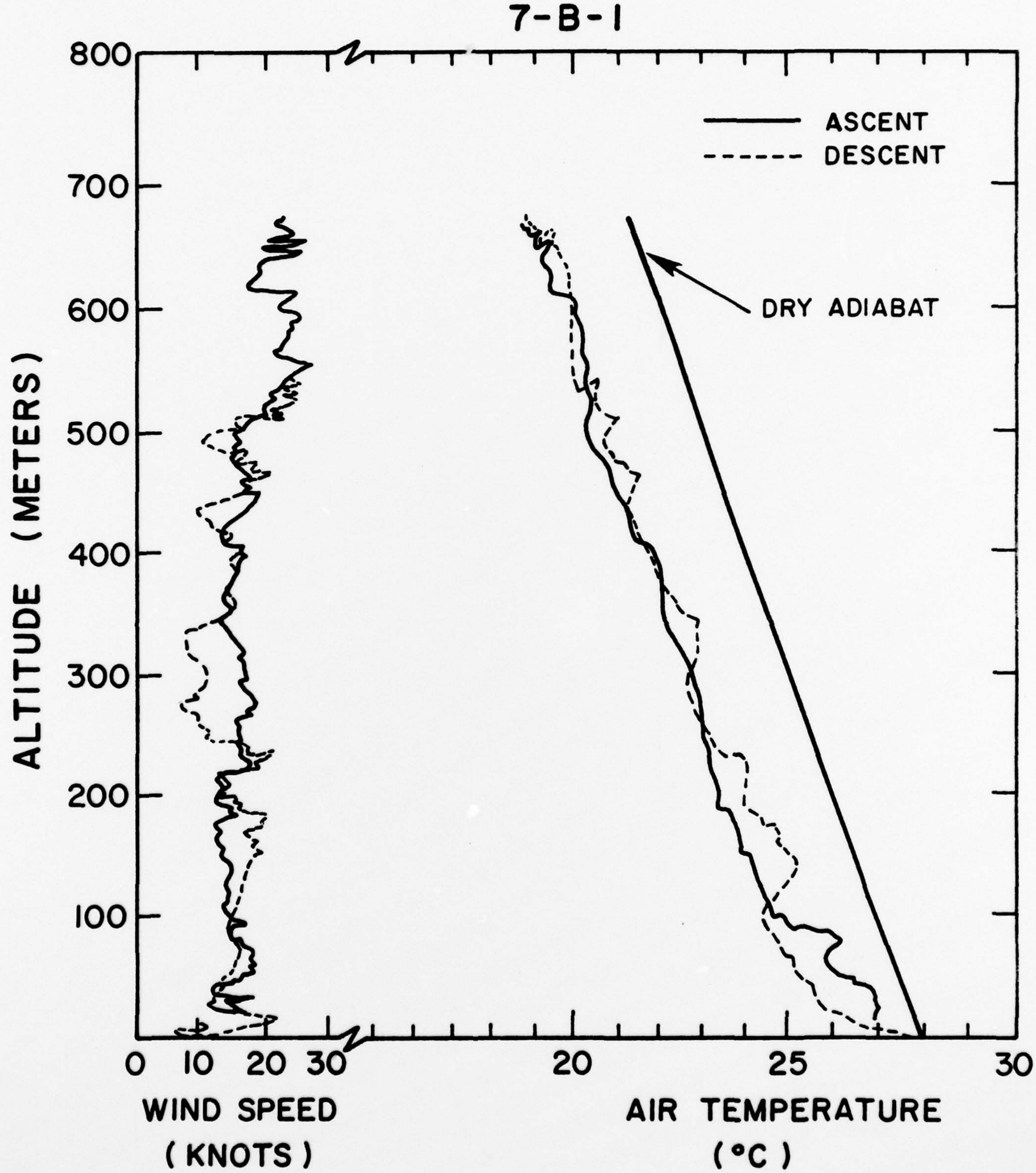

7-B-1
800
700
600
500
400
300
200
100
ALTITUDE (METERS)
ASCENT
DESCENT
DRY ADIABAT
0
10
20
30
20
25
30
WIND SPEED
(KNOTS)
AIR TEMPERATURE
(°C)

Figure 6.

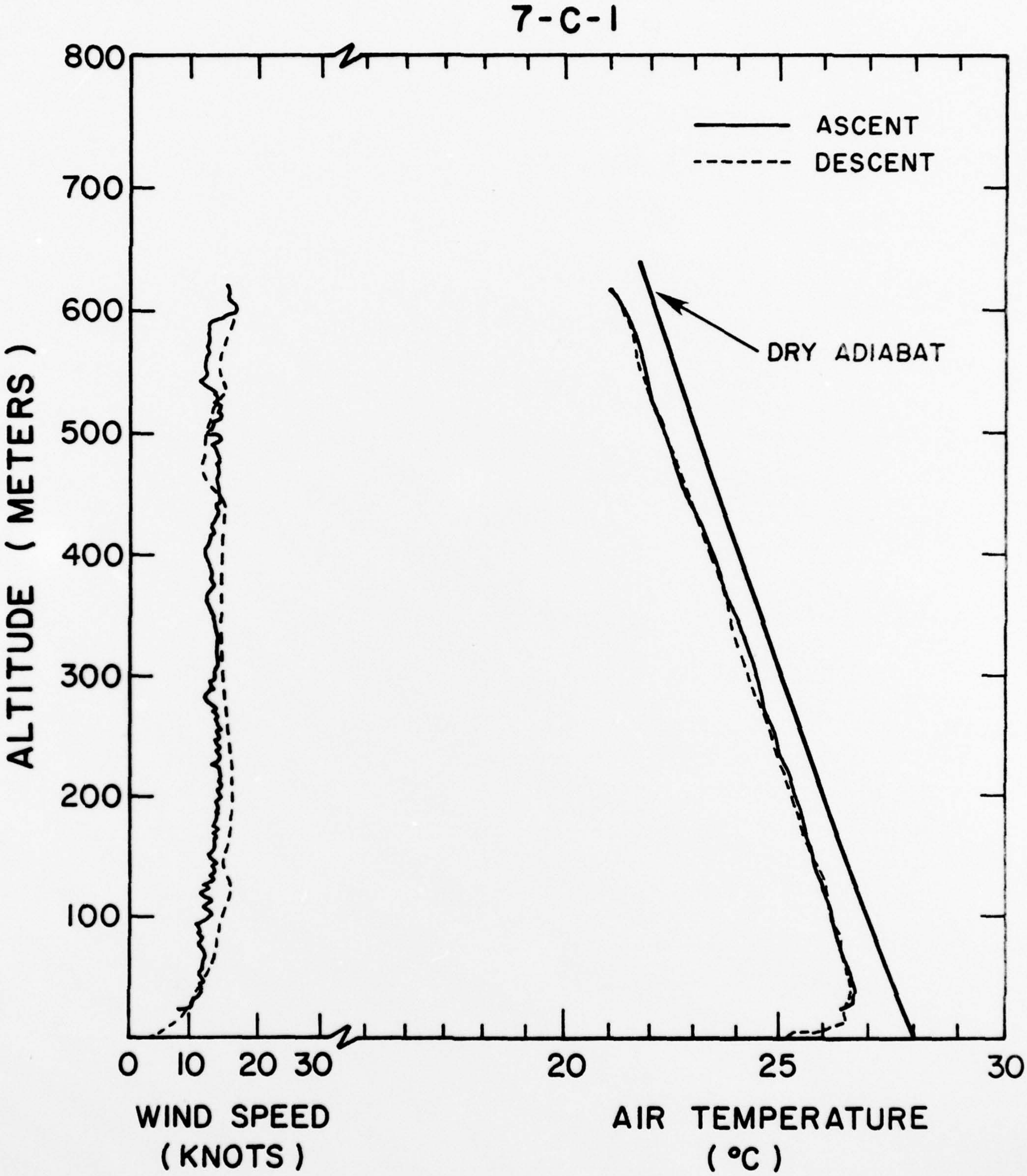

7-C-1
800
700
600
500
400
300
200
100
ALTITUDE (METERS)
ASCENT
DESCENT
DRY ADIABAT
0
10
20
30
20
25
30
WIND SPEED
(KNOTS)
AIR TEMPERATURE
(°C)

Figure 7.

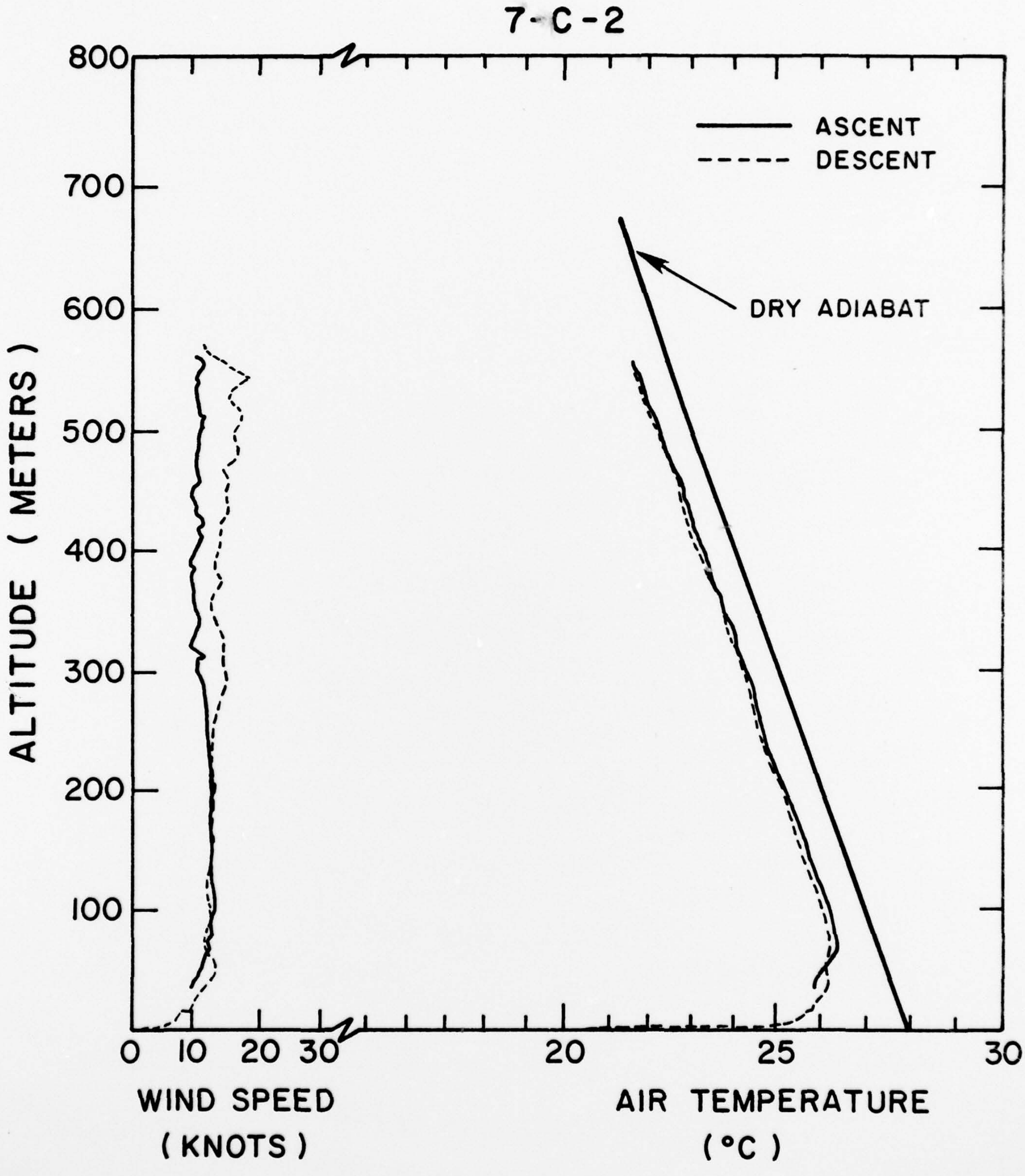

7-C-2
ASCENT
DESCENT
DRY ADIABAT
ALTITUDE (METERS)
800
700
600
500
400
300
200
100
0
10
20
30
20
25
30
WIND SPEED
(KNOTS)
AIR TEMPERATURE
(°C)

Figure 8.

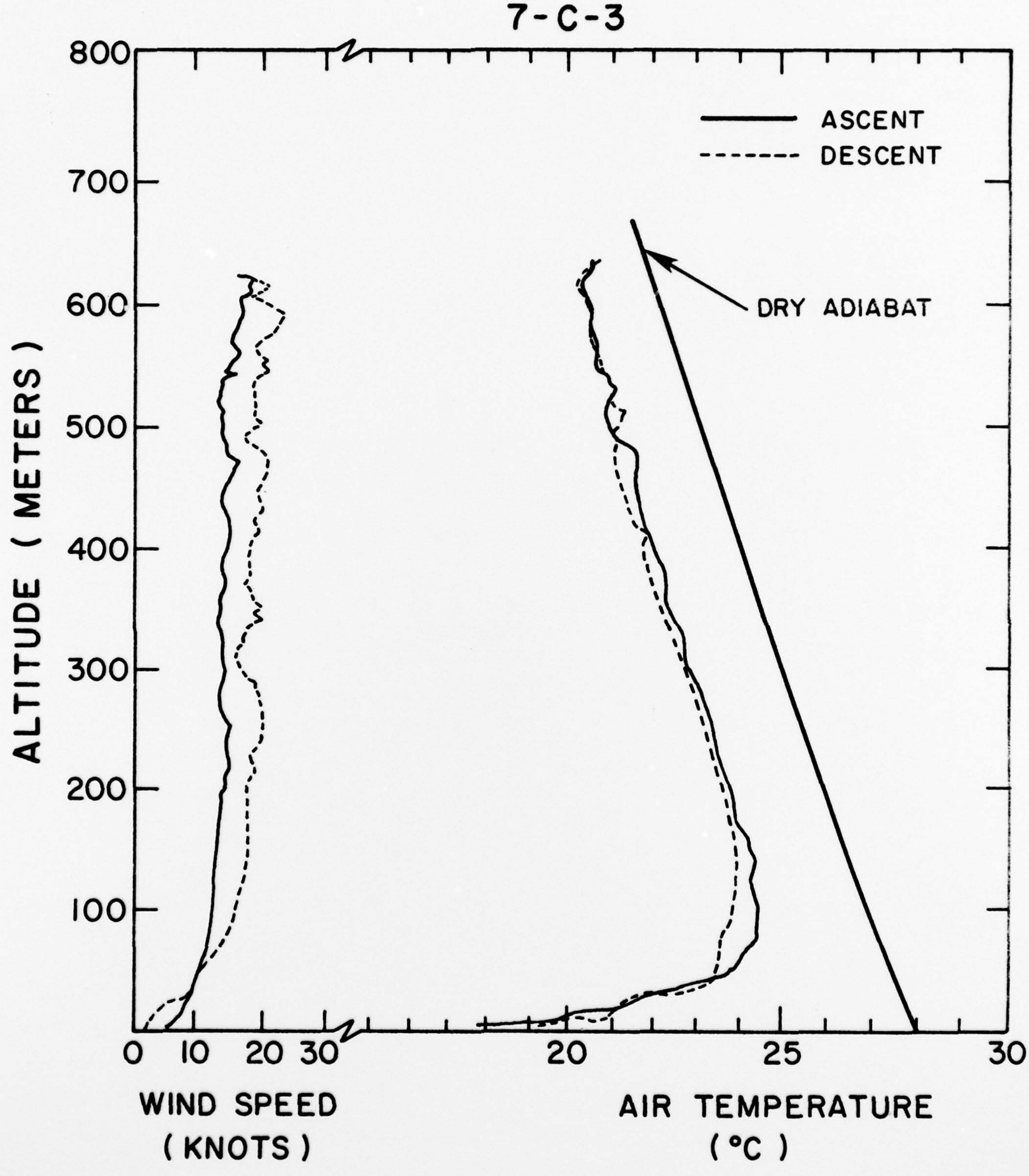

7-C-3
800
700
600
500
400
300
200
100
ALTITUDE (METERS)
ASCENT
DESCENT
DRY ADIABAT
0
10
20
30
20
25
30
WIND SPEED
(KNOTS)
AIR TEMPERATURE
(°C)

Figure 9.

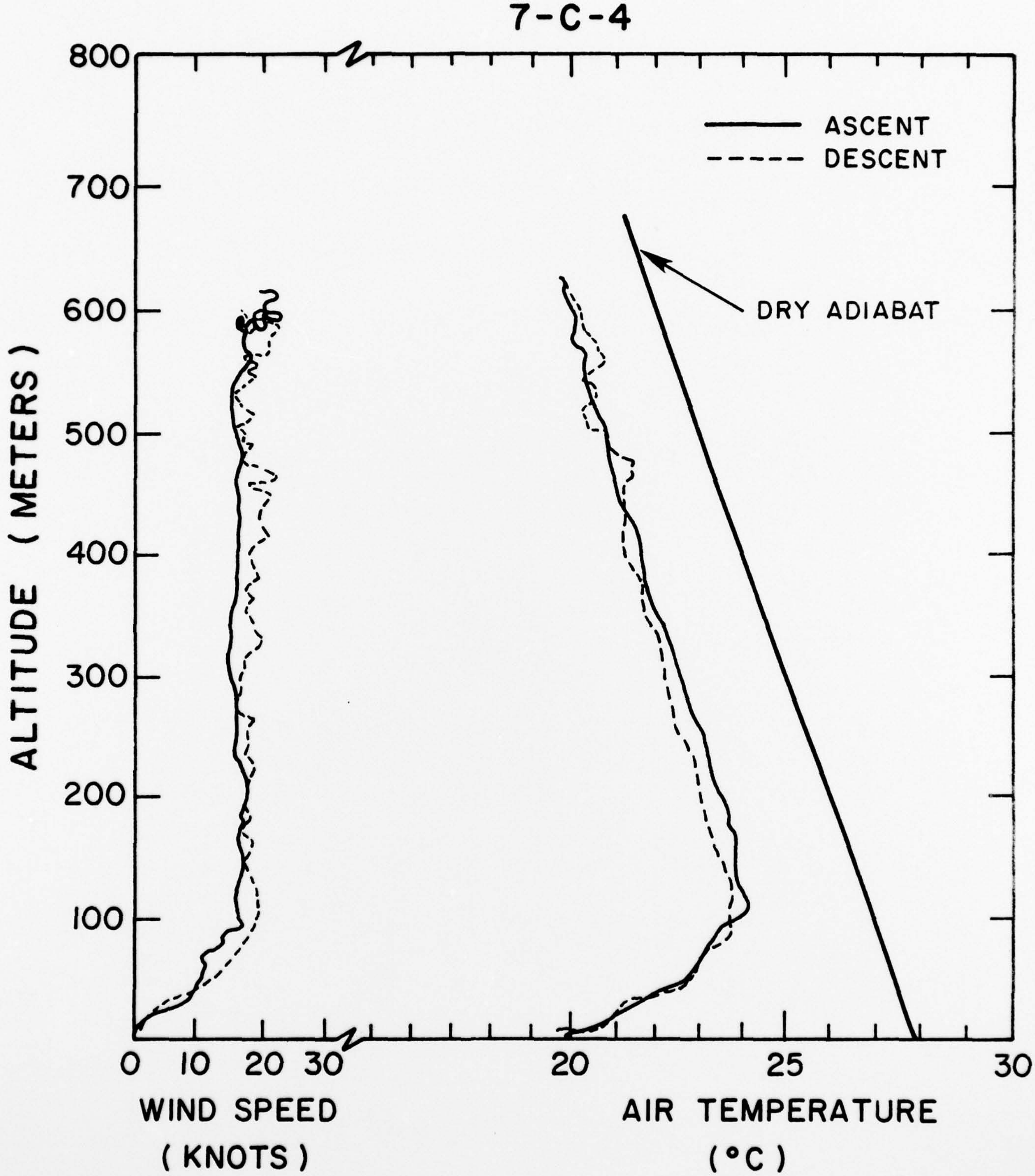

7-C-4
800
700
600
500
400
300
200
100
ALTITUDE (METERS)
ASCENT
DESCENT
DRY ADIABAT
0
10
20
30
20
25
30
WIND SPEED
(KNOTS)
AIR TEMPERATURE
(°C)

Figure 10.

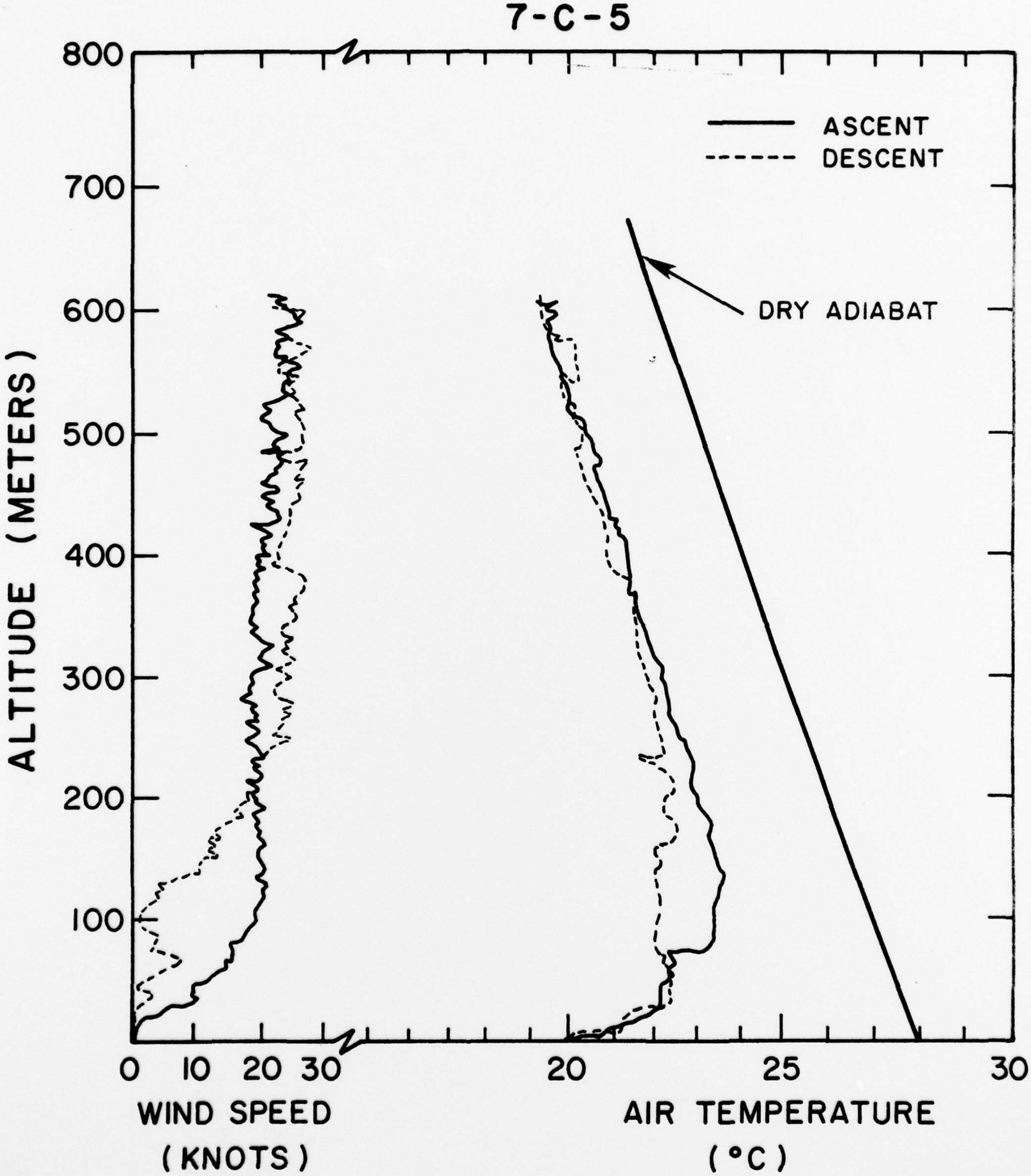

7-C-5
ASCENT
DESCENT
DRY ADIABAT
ALTITUDE (METERS)
800
700
600
500
400
300
200
100
0
10
20
30
20
25
30
WIND SPEED
(KNOTS)
AIR TEMPERATURE
(°C)

Figure 11.

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Spell out White Sands Missile Range

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During the first two weeks of April, 1978, tethered balloon soundings were conducted at WSMR. Vertical profiles of aerosol concentration, temperature and wind speed were obtained. The results show very little change in aerosol concentration with altitude suggesting that a measurement at 5 or 6 meters above the surface would provide concentrations typical of at least the first 700 meters.

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